Proceedings of the

Seventh Conference on Maple Products

October 8-9, 1968

Philadelphia, Pa.

Agricultural Research Service
U. S. DEPARTMENT OF AGRICULTURE

Proceedings of the

SEVENTH CONFERENCE

ON MAPLE PRODUCTS

Held October 8-9, 1968

in Philadelphia, Pa.

at the

Eastern Utilization Research and Development Division

Agricultural Research Service

United States Department of Agriculture

PREFACE

The seventh conference on maple products held on October 8-9, 1968, at the Eastern Utilization Research and Development Division, Agricultural Research Service, U. S. Department of Agriculture, Philadelphia, Pa. 19118, was attended by representatives of the Governments of the United States and Canada; State governments; the State agricultural experiment stations; the extension services; universities; maple producers, processors, and distributors; and equipment manufacturers. Names and addresses of conferees are listed at the end of this report.

When the papers reprinted or summarized in this publication were presented, the conferees saw a demonstration of the partial concentration of maple sap by the EUROC, Eastern Utilization Reverse Osmosis Concentrator.

Mention of companies or commercial trade names in this publication does not imply endorsement by the U. S. Department of Agriculture over others not mentioned.

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[In a few welcoming remarks, Dr. P. A. Wells, Director of the Eastern Utilization Research and Development Division, looked back to 1950 when this triennial series of meetings started, and expressed his gratification that they have served such a useful purpose to the maple industry. Then he turned the floor over to Dr. C. O. Willits to set the theme for this seventh conference.]

CONFERENCE THEME

C. O. Willits
Head, Maple Investigations
Eastern Utilization Research and Development Division
Philadelphia, Pa.

On behalf of my associates, Dr. J. Clyde Underwood, Mr. John Kissinger, and Mr. Ransom A. Bell, of the Maple Investigations, and Dr. J. W. White, Chief of the Plant Products Laboratory, I wish to extend our greeting and welcome to this, the 7th triennial maple industry conference.

The theme of the conference is RESEARCH FOR AND THE PROMOTION OF THE MAPLE INDUSTRY.

The work done in the three years since the last, or 6th, conference covers a wide range of topics, and the papers are just as challenging as were those presented at the first conference held 18 years ago.

It is gratifying to report that the results of the cooperative study on early tapping which were presented at the "round table" (a feature of the last conference) have become widely accepted. Although 1967 and 1968 were short sap-crop years, early tapping permitted many producers to obtain a near-normal crop.

The research accomplishments of the past three years which will be described here are even more exciting. These include methods to increase sap yields per flow period, to improve sap harvesting, and to extend the time that sap can be safely stored, as well as a study of the effects of soil temperature on sirup quality and development of an entirely new and practical concept for sap concentration.

The work done on the promotion of the maple industry is equally challenging. The papers will include inter- and intra-State as well as international developments sponsored by the Extension Service, the State Departments of Agriculture, maple producers associations, and entrepreneurs of central sap plants.

Let me call attention to the publications on display in the adjacent corridor. These are exhibits only, so please do not remove them. Forms are available so that you may request any or all to be sent to you.

THE MAPLE INDUSTRY IN PENNSYLVANIA

Opening Remarks by the Chairman
Edward P. Farrand, Extension Forester
Pennsylvania State University
University Park, Pa.

You have been welcomed to the Wyndmoor research laboratory and to Philadelphia. I would like to welcome you to the Keystone State with the hope that you will see more of it before you leave.

In the present trend of increasing population, increasing prices, and increasing taxes, it is difficult to realize that a State like Pennsylvania is also increasing its acreage of forest land. A recent survey showed that between 1955 and 1965 there was a 2-million-acre increase.

We now have 17 million acres of forest land which is 60% of the total land area of the State. However, since the number of tappable trees is usually not a limiting factor to maple sirup production in this State, the effect of this increase on the maple industry is not the usual one. Tourism and outdoor recreation are increasing every year and Pennsylvania because of its location is becoming the playground of the Megalopolis. This offers prime opportunities for marketing maple products to tourists and recreationists.

Pennsylvania producers have now endured two poor seasons with production reported at approximately 70,000 gallons of sirup each year. Our normal production is over 100,000 gallons. The number of producers has been decreasing which indicates the trend toward larger single production units.

The theme of this conference is research and promotion. In order for the research to be meaningful, all of us here should apply the results and inform other producers of the results of current research. This is a big job of education by you as leaders of the maple industry. Promotion is also a form of education, but here the recipient is the general public--the consumers of our maple products. It is a challenge to all of us to continue to encourage the use of pure maple products.

MAPLE SIRUP RESEARCH AT CORNELL UNIVERSITY

Robert R. Morrow, Jr.
Associate Professor of Forestry
Cornell University, Ithaca, N. Y.

Three years ago Cornell's expanded maple research program was announced. A 60-by-24-foot sugar house to accommodate a 4,000-taphole operation has been established at Heaven Hill Farm, Lake Placid, New York. Intensive production and cost studies have been made and results compared with those from the Arnot Forest (1,300 taps) in southern New York.

Cost Studies

Cost studies should be made to show the relative efficiency of different portions of a maple enterprise. Thus sap production costs can be separated from the cost of conversion to sirup. Likewise canning and marketing costs can be separated. In this way, one can determine the value of raw sap, drum sirup, and canned sirup for either the wholesale or retail market.

For three years of operation at Heaven Hill, the percentages of total cost for sap production, sirup conversion, canning, and marketing were 40, 31, 17, and 12 percent, respectively. These figures are only illustrative. The sirup conversion cost is abnormally high because the building and evaporating equipment is not used to capacity. Depreciation, interest, taxes, and insurance on the building and evaporating equipment are fixed costs--yearly costs that are unaffected by the amount of sap boiled. These costs were nearly half of the evaporating cost and can be reduced only by producing or purchasing more sap. The remaining costs, primarily fuel and labor, are mostly variable costs; i.e., they vary in proportion to the amount of sap or inversely with sugar percentage of the sap. For the smaller Arnot operation, sirup conversion cost was 40 percent of total cost.

Canning costs are primarily direct costs of the cans, labels, and labor. The relatively high cost at Heaven Hill reflects the high proportion of sirup sold in quart and pint containers.

Marketing costs are often neglected in cost studies. At Heaven Hill, they include attractions such as an educational exhibit, brochures, and roadside signs. Sugar house costs including toilets, exhibit space, sirup storage and sales space are marketing costs, as are sales labor, delivery cost, and parking space. Canning and marketing costs can be recovered only by selling at suitably high prices.

Numerous labor-saving devices continue to be used in the maple industry, thus ever increasing capital or fixed costs. This trend puts a premium on high production per tap hole or per unit of equipment to reduce these costs.

Sap Production and Cost

(1) Sap flow per taphole is low at the 2,000-2,500 foot elevations at Heaven Hill. In comparison with Arnot Forest, March and early April temperatures are about 9°F. lower. This greatly delays the season and reduces the flow during the season. But from mid-April on, there is often little temperature difference; buds come within a week or so after they appear at Arnot Forest. In ordinary years Arnot sirup production per taphole is nearly double that at Heaven Hill, while sugar content is about the same (about 2 percent).

(2) Sap collection cost can exceed the purchase price of sap. This cost, based on 4,000 taps, for an all-tubing system (buckets would cost much more) is as follows:

Depreciation and interest ($8,000, 12 yr., 5%)	$ 900	23¢/tap
Labor (8 min./tap)-(533 hr., $1.60/hr.)	850	21¢/tap
Pellets, Clorox, fuel, repair, misc.	160	4¢/tap
Land and trees (cost of ownership, timber loss)	400	10¢/tap
	$2,310	58¢/tap

Note that sap costs for a tubing network are almost entirely fixed costs; i.e., they remain the same regardless of whether or not any sap flows. Therefore high production (big sap flow, sweet sap, or a combination of both) is needed for efficiency. At a cost of nearly 60 cents per taphole, the average woods tree that produces 2 percent sap must yield 12 gallons of sap to break even when the purchase price of sap is 5 cents a gallon. When the cost of transportation to the evaporating plant is added, the yield must be even more. With the unfavorable weather conditions at Heaven Hill, yield has been only 8 gallons of sap per taphole; it would be obviously more economical to purchase sap if it were available.

(3) Even though sap production costs have been reduced by the use of plastic tubing and pipelines, they are the most costly part of the maple business. Over 60 percent of our labor and 40 percent of our total costs (including marketing) go into sap production.

Most producers have a better production situation than at Heaven Hill, but many still produce less than a quart of sirup per taphole. These producers at best would appear to break even on the sap production part of their business. The high cost (and low returns) of sap production surely has caused many to go out of business in the past, and more will follow them. There are doubtless others who lose money producing sap, but who make it up in other phases of the business.

Sap Flow-Vacuum

Recent research has demonstrated the potential for increasing sap flow by either natural or artificial vacuum. Problems remain with regard to practical application of vacuum. These problems are: (a) How best to lay out tubing to take advantage of natural vacuum and (b) How best to reach large numbers of trees (or distant trees) with artificial vacuum.

(1) Natural vacuum is desirable on sloping land where artificial vacuum is impractical (large remote areas or small areas with too few taps). At Heaven Hill, we attempt to obtain natural vacuum by a tapping prescription which features aerial tubing without vents, preservative-treated wood props to reduce tubing sag when space between trees exceeds 25 feet, numbering of all trees and use of tube-holding device to permit yearly return of tubing to same tree, and early (fall or winter) tubing layout followed by spring tapping. This prescription appears likely to provide some natural vacuum while requiring a minimum of tubing and eliminating the need to pull tubing from snow in midseason. Also the tube layout work can start earlier and the tube holder reduces layout time.

(2) Artificial vacuum is an inherently inefficient means of moving liquid. Uphill pulls cannot exceed 20-25 feet; tubing network leaks limit distance. Possibilities for extending artificial vacuum are as follows:

(a) Sustained vacuum--maintained by large reserve tank with several sap lines.

(b) More vacuum from large motors and pumps--untested.

(c) Distribution of vacuum--several small motors

1. gas motors--need too much attention
2. electric motors--can utilize old wire, trees to distribute power
3. central motor--distribute vacuum through half-inch pipe to dumping unit in woods
4. combinations

Vacuum, despite its potential, is no panacea. Many places exist where installation of power may be impractical. Even natural vacuum in unvented aerial tubing has limitations. On very steep slopes, it probably makes no difference whether tubing is vented or unvented. On very shallow slopes of 2 percent or less, the vented system described recently by Sipple for flat land may be better.

RESULTS OF TUBING RESEARCH BY THE U. S. FOREST SERVICE

Carter B. Gibbs
Silviculturist,
Northeast Experiment Station, Forest Service
U. S. Department of Agriculture, Burlington, Vt.

Tubing research by the U. S. Forest Service was begun at Burlington, Vt., in the spring of 1966. In the past three seasons work has been completed in four general categories: (1) vented and unvented aerial installations; (2) vented and unvented groundline installations; (3) vented aerial and groundline installations; and (4) the use of artificial vacuum.

Tubing installation and tapping procedures were rigidly controlled in all experiments. Tubing was 5/16 inch in diameter and tapholes were 3 inches deep exclusive of bark thickness. In each comparison the tapholes, drops, and lines were paired so that the only difference between installations was in the methods being evaluated.

Vented and Unvented Aerial Installations

In 1966 comparisons were made between 15 vented and 15 unvented lines, each with 20 tapholes. Total seasonal yields from the unvented lines were 40 percent greater than those from the vented lines. Yield differences were found to be related to the natural vacuum developed by the weight of the sap in the unvented lines.

The study was repeated in 1967, with the cooperation of private landowners; and yield increases of 34 percent in favor of the unvented lines were obtained. Again the increase in yield was attributed to the presence of natural vacuum in the unvented installation.

Vented and Unvented Groundline Installations

The study of vented versus unvented lines was continued in 1967 with groundline installations. The unvented lines yielded more sap than the vented lines, but the difference was only 8 percent. Natural vacuum did not develop to any marked degree in the unvented lines. We believe that the lack of long slopes in the groundline installations prevented the development of natural vacuum.

Vented Groundline and Aerial Installations

In 1968 we compared vented aerial and groundline installations on the same 15 replications used for the vented-vs.-unvented comparisons. The season was extremely poor, but the aerial lines yielded 9 percent more sap than the groundlines. The reason for this difference is unknown, but at this time we do not feel it is of practical significance.

Vacuum Pumping

The presence of natural vacuum in unvented tubing led us to investigate pumping with a jet-type vacuum pump. In 1967 we paired spouts, vented and unvented, on 171 trees and vacuum-pumped the unvented lines. Total seasonal yields for the vacuum-pumped lines were over 300 percent greater than those for the vented gravity-flow lines. Also, through dye and pressure-dissipation experiments on paired individual trees, we determined that we were actually pumping sap from the trees.

In 1968 we compared yields between 30 paired trees: 15 were vacuum-pumped and 15 were hung with buckets. The pumped trees yielded 250 percent more sap than those not pumped. We also found, through cooperative research, that pumping increased yields on slopes in commercial type operations and on level or slightly downgrade slopes in experimental areas. The major advantage of vacuum-pumping seems to be that it not only increases normal yields but also produces sap at temperatures above 35 degrees when gravity flow does not occur.

Future Plans

Our future work will include a comparison of unvented aerial and ground-line installations and investigation of the effects of line slope on natural vacuum levels developed in unvented installations. We also plan to do more research on the many problems associated with the use of vacuum-pumping.

THE MACDONALD COLLEGE SUGAR MAPLE RESEARCH PROGRAM

J. D. MacArthur
Asst. Prof., Department of Woodlot Management
Macdonald College, P.Q., Canada

It is an honour and a pleasure to represent Macdonald College here today and to be one of those representing the Province of Quebec at this important conference. As some of you will remember, Professor Arch Jones has spoken to you before about the work at Macdonald College and probably one of the reasons that the program has continued to grow and develop has been the stimulation received at past maple conferences here in Philadelphia.

My talk today will be an attempt to sketch briefly why and how the Macdonald College program developed.

Sugar maple research has been in progress at Macdonald since 1956. Prior to that time, and for many years, the trees that we are now using were tapped for strictly commercial maple sugar production. Following visits to the United States, Professor Jones initiated work in 1956 and from a small original effort the maple work has become an important part of the diverse activities in the Department of Woodlot Management. In the early years the work was pushed forward largely by enthusiasm, but today support is growing in the form of Federal and Provincial research grants and donations of material and equipment from manufacturers. We are not, however, likely to fall victims to complacency when we see the elaborate research going on here to the south of us.

As you probably know we Quebecers actually produce about 69 percent of the world crop of maple products - versus 24 percent in the U.S. With 21 million taps being harvested now and a potential of about 100,000,000 more in Quebec you may well wonder why the work I am about to describe has been so limited. Under the circumstances, however, we feel that we have done rather well up to now, but in future we hope and expect to do much more.

The staff members of the Department of Woodlot Management in the Macdonald College, Faculty of Agriculture, are engaged in the broad field of woodlot management including teaching, extension, and research in many phases of forestry and resource management. A large portion of the departmental budget consists of revenues from sales of various forest products from our 600-acre demonstration woodlot - the Morgan Arboretum. Consequently, there are within the operation many conflicting demands for the rather scarce resources.

Some external factors have also influenced our activities. Sugaring is still, with some notable exceptions, largely in the cottage industry stage in Quebec. It is a highly traditional and individualistic activity. In most cases it is seen as an adjunct to the farm - a source of cash income at a time when cash is badly needed.

Earlier objectives, therefore, were to work on such projects as would make existing operations more rewarding. Being closely associated with farm and woodlot owners we have always been extremely conscious of their pressing need to improve their revenues. It was hoped that some measure of success on these problems would in turn draw support for other and more far-reaching projects, and this hope now seems to have been justified.

Specifically early work was on testing and adapting plastic tubing sap-collection systems, methods of vacuum pumping, chemical sanitization of tap-holes, and in short anything that seems likely to have the effect of reducing operating cost. This work led into studies of sap sugar content, effects on tree tap-hole sanitization, squirrel damage to plastic tubing, and eventually sugar maple silviculture.

Plastic tubing and tap-hole pellets were already coming into wide use in the U.S.A. when our work began. However, we feel that in Quebec our results and demonstrations have significantly hastened the adopting of these labour-saving and cost-reducing methods here. While we may at times wish that it were otherwise, the fact that our sugaring operation is highly commercial - we need the money - lends credibility to our demonstration.

The Morgan Arboretum sugar maple resource occupies some sixty acres and consists of ten stands ranging in area from 1.3 to 18 acres. The number of taps is about 3,000. The land is generally flat with minor but disconnected slopes. Sugar maple is the main species but there is an appreciable representation of other species such as basswood, elm, white ash, hickory, and red oak. The climate, on the west end of Montreal Island, is not typical of the sugar maple country of Quebec. Spring comes early, and ideal conditions of cold nights and warm days are less frequent or prolonged than most of the Quebec maple region.

Taphole Pellets

The earliest work at Macdonald was on taphole pellets. This had high priority because it offered a potential saving for both tubing and the conventional installations. While it had shown great promise in the U.S. there was still doubt that it would work as well in the different climates of Quebec.

In 1961, four test groves were set up in the Arboretum. Each consisted of six groups or lines of ten trees where gravity flow could be achieved. A ten-tree group was a treatment unit. Each tree carried two taps, one treated and one control. The ten treated taps were connected by a tubing line and led into a collecting tank - similarly with the controlled taps. Yields from the two taps were treated as a paired comparison. Together, the four test groves of six ten-tree units each, provide twenty-four comparisons. Accumulated yield records indicate that the four groves vary consistently in yield and they are assumed to represent considerable variation.

The first taphole pellet studies involved several agents. Results encouraged further work, and by 1965 conclusive results using commercial paraformaldehyde pellets were obtained. Yields from pelleted tapholes were consistently higher in all four test groves. Pelleting increased yields by 53% and significantly reduced the number of micro-organisms present in the sap. These results, and our intention to pellet all tapholes in future, were reported in the Macdonald Farm Journal (also in Forestry Chronicle - first maple article). At the beginning of the next maple season we were gratified to receive numerous requests for information on the once-scorned "pills."

Tubing

With tubing it was again a question of starting from scratch. The producers simply did not believe that tubing yields would be as good as those from buckets. We may not have been entirely convinced ourselves, but were anxious to check out all possibilities of improving our operation.

Some early work (1962) had suggested that bucket and pipeline yields were roughly the same but replication was limited. However, in 1966 a formal experiment with 480 taps demonstrated that tubing yields with the 3M 18-inch system were at least as good as buckets and quite possibly higher.

In 1967, again in search of small but immediate savings, we tested different groves drop lengths with Mapleflo tubing. Earlier results showed that the 18-inch drop was greatly superior to non-drop installation. In 1967, 18-inch, 12-inch, and 6-inch drops were compared using Mapleflo tubing and fittings. The data indicated that all three lengths gave similar results. This suggests that there is a possible saving of a foot of tubing per tap with a significant financial advantage as well as some simplification in tapping.

A moment of truth was reached in 1968. Mapleflo and **Naturalflow** systems had been compared but results were somewhat inconclusive. In 1968 Mapleflo

18-inch drops, Naturalflow 18-inch drops vented and Naturalflow 18-inch unvented insulations were compared. To our considerable astonishment, yields were not significantly different. Astonishment changed to concern when we saw a report of a somewhat similar study (Blum, 1967).[1/] Needless to say this matter will be pursued most diligently in 1969.

In our generally flat area, vacuum pumping seems to offer good possibilities. We have been testing pumps on a semi-experimental level for several years. Tests of several pumps have indicated that reliability and economy are the main factors to consider and that different types may work equally well.

The critical factor in our vacuum pumping has been tubing installation. Our tests soon convinced us that non-drop systems yield poorly even with vacuum. This was verified by hanging duplicate tubing systems in a 450-tap grove with duplicate pumps and collecting tanks. The only difference was that one had 18-inch drops and the other none.

This same double system was used in 1968 to compare yields from 18-inch and 6-inch drop systems. Several factors confused the picture somewhat but the similar yields recorded are what we expected. Since we cannot replicate in this test, repeats are necessary, and this was a start year for comparison of drop length with vacuum pumping.

Squirrel Damage

The biting and chewing of plastic tubing by squirrels is a serious problem from time to time. Damage can be so heavy that many producers would not dare to use tubing and risk disaster. As victims of squirrel damage we are extremely anxious to find a remedy, and have taken steps to do so in collaboration with our biologist colleague in the Department, Dr. Roger Bider, and with the assistance of the people at 3M.

In 1967, squirrel damage was mapped in the 10-acre grove. In 1968, different types of tubing, including blue Naturalflow and specially produced black opaque 3M type, were installed in the sections most heavily damaged in 1967. It was hoped that we would succeed in comparing damage levels. Also, once we knew by observation that the squirrels were active, Dr. Bider proposed to attempt to decoy them with a readily available 3 percent sugar solution in strategically placed drinking troughs. This approach was based on the theory that the squirrels, particularly lactating females, bite tubing because of thirst.

Unfortunately, squirrel damage was rather light and the plans did not materialize. It was, however, observed that damage was largely restricted to clear tubing. Here again we must fall back on the old Brooklyn Dodger philosophy and hope for better cooperation from the squirrels in 1969.

1/ Blum, Barton M. 1967. Plastic Tubing for Collecting Maple Sap. A Comparison of Vented and Unvented Installations. U. S. Forest Service Research Paper NE-90.

In 1962, a study of the closure of pelleted and unpelleted tapholes did not disclose significant differences. Continuing concern regarding adverse effects of chemicals led to another study in 1968. Pelleted tapholes made in 1966, 1967, and 1968 were checked, as well as the vigor of the trees. Again, nothing startling was produced. Sectioned trees did not display rot that could be ascribed to the effects of pelleting. While adverse effects cannot be ruled out, they were not obvious.

However, current plans are to develop a special study. A number of trees of different age, size, vigor, etc., will be chosen for experiments comparing pelleted and unpelleted tapholes. The experiment will conclude with dissection of the trees to examine effects of overdosage, normal dosage, and no treatment on tapholes.

Maple Silviculture

The Department is now in the process of developing a long-term research project which we expect will become an elaborate study of the development of a producing sugar maple stand from what is now the sapling stage. Plans are to observe, to study, and to manipulate the development of this sapling stand as it develops into an ideal sugar bush. With a view to using computer analysis to guide our decisions and studies, the trees have been measured and mapped and these data recorded on IBM cards. While still in very early stages of development, we are highly impressed with the assistance available from the computing center. The ability to select from the total tree population all individuals having certain characteristics in common and to map their location in relation to each other greatly simplifies some of the experiments that we hope to conduct. Studies of sap sugar content and of responses to thinning and to fertilization will be greatly facilitated.

The Future

So far, gentlemen, we have been discussing the past, and largely our restricted efforts to discover ways of making small economies in the production of maple products by the small individual producer. Events in Quebec now suggest that there is a move afoot to develop larger maple operations through central evaporation and purchase of sap at roadside, and this change will depend largely on the new technology of pills, pumps, and tubing. Our past work has been successful in two respects. We have some financial support for our work from the Provincial and Federal Departments of Agriculture. This support will remove some of the commercial pressure we suffered in the past and permit us to become more aggressive in our research program. We certainly hope to be here once again in 1971 with a new story to tell.

THE NATIONAL MAPLE SYRUP COUNCIL

Ture L. Johnson, President
Burton, Ohio

As President of the National Maple Syrup Council, it is a pleasure to extend greetings to you all from the Council.

I believe most of you know the reasons for having a Council, its functions, and its goals, so we will not delve into this.

The Council met in official session yesterday (October 7) here at the Laboratory.

One of the most important points covered was a report from our maple syrup grades committee on recommendation for changes in the names and requirements of the four maple syrup table grades. We should all compliment this committee on the big step in the right direction which it has taken. Now we will have a standard to go by, and it is up to each director to take this information back to his own State for discussion, so we may bring about more uniformity in the maple syrup industry.

The Council also passed a motion inviting the Canadian Provinces into the Council as associate members.

The Council is always looking for publicity and recognition for the maple industry. It publicizes the dates of the Council meetings in newspapers, university publications, and farm magazines, and selects a national maple queen. This coming year, 1969, at our Council meeting in Ohio, we are going to endeavor to have the national maple queen in attendance to appear on TV and radio.

A recommendation was made for more research on reduction of fuel costs. We hope this will be carried out either by the States through university research or by the Federal Government research laboratories.

A research study should also be started on what type of material to use in tubing to discourage rodent damage. At the present time, both national and state laws prevent us from spreading poison bait; there are also laws that prevent the mixing of chemicals in tubing to discourage rodent damage.

The Council extends to you an invitation to attend its annual meeting in 1969 at Burton, Ohio, on October 20 and 21. The fly in the ointment is that if you are interested in coming, your reservation for a room at the Manor House or cabin should come to us relatively early. Bring your golf bag--a new 18-hole course will open in the spring of 1969.

The Council wishes to thank the producers and other maple industry people who attended our meeting. We also wish to thank all of you that advertise in our National Maple Syrup Digest.

REPORT OF THE NATIONAL MAPLE SYRUP DIGEST

Lloyd H. Sipple, Editor

Financial report

Balance on hand July 1, 1967			$1214.33
Receipts:			
Advertising	6704.19		
Contributions & Subsc.	1252.25		
Total		7956.44	
Disbursements		7619.93	
Net gain			336.51
Balance on hand August 31, 1968			1550.84

Number printed (October 1968 issue)		8700
Circulation:		
Mailing	6835	
Extra copies to delegates, foresters	990	
Canadian subscriptions	90	
Extra copies to Canada	450	
Total		8365
Balance for stock		335

Notes

Digest mailed to 25 States and D.C.

Northeast: Maine, N. H., Vt., Mass., Conn., N. Y., N. J., Pa.

Midwest: Ohio, Ind., Ill., Mich., Wis., Minn., Iowa, Mo., N. Dak.

South: Md., Va., W. Va., Ky., D.C.

Southwest: Texas, N. Mex.

Northwest: Oregon, Alaska

Canada: Ontario, Quebec, Nova Scotia, New Brunswick

Afternoon Session, October 8

Chairman: Melvin M. Koelling

MICHIGAN'S MAPLE SIRUP AND SUGAR INDUSTRY

Opening Remarks by the Chairman
Melvin M. Koelling
Extension Specialist in Forestry
Michigan State University
East Lansing, Mich.

The maple sirup industry in Michigan has held its own in line with national production. In 1964, Michigan ranked fifth with a production of 96,000 gallons of sirup. In 1968, it still remained in fifth place with a production of about 75,000 gallons.

The production trend in Michigan again follows the national trend in that the smaller producer is declining while larger, more integrated operations are increasing both in size and production. In addition to one large central evaporation plant, several individual producers buy sap from surrounding woodlots.

Marketing maple products throughout most of Michigan is not a large problem. In fact, the demand far exceeds the available supply. This fact has been emphasized during the past two seasons in which rather small crops were produced. While the majority of all products are sold in roadside stands and local retail outlets, some bulk sales are also made. Primarily this consists of lower quality and late season sirup.

Considerable effort is given to educational programs for maple producers in Michigan. Each spring maple institutes are held throughout the State at which information is given on production, processing, marketing, and new research results are presented. These meetings are well attended and assist in promoting the maple industry.

In conclusion, the maple industry in Michigan appears to be a relatively stable one. Sugar houses are being modernized and general production sanitation is increasing. The possibilities for expansion of the industry are large, as there are many young untapped stands. Furthermore, an expanding tourist industry presents a larger potential for marketing. Labor continues to be a problem, but helping to solve it are the adoption and use of more efficient field techniques such as tubing and automatic sirup production equipment.

OUR SUGAR MAPLE RESOURCE:

REPORT ON THE HOUGHTON SUGAR MAPLE CONFERENCE

Albert G. Snow, Jr.
Principal Physiologist,
Northeastern Forest Experiment Station
Forest Service, U. S. Dept. of Agriculture
Burlington, Vt.

The keynote address of the Houghton Sugar Maple Conference, given by Edward P. Cliff, Chief of the U. S. Forest Service, concluded with: "When this conference ends, our work here will have really just begun. Some of you will go back to forests and mills to put latest knowledge about maple to immediate use, and others will return to experimental plots and laboratories determined to find the answers to the questions posed here." The result, he said, will be "more and better maple trees; more and better maple products and jobs; and better living."1/

More than 50 specialists told the more than 250 participants in the Houghton conference what is known--and not known--about the sugar maple resource that is so important to the maple sugaring industry. The consensus of their reports was that there is a good potential for sugar maple sap production--and for timber production.

The maple sugaring industry depends on a tree resource spread over 33 million acres of land. Recent survey reports indicate that the total supply of sugar maple is increasing three times as fast as it is being cut, but 60 percent of the volume is in trees less than 17 inches in diameter. There are enough sound and accessible trees to support sap production operations greatly in excess of those now in existence.

Most high-quality timber products of sugar maple will continue to come from natural stands. Yet the time is not too distant when planting of sugar maple will be more common. Through genetic improvements, the trees in these plantations of the future will have a higher rate of growth, less forking, and sweeter sap.

Most past efforts to establish sugar maple plantations by seeding and planting have failed. However, through recent research on seed handling, nursery practices, and outplanting procedures, we are beginning to find some of the answers to successful establishment. The problems of vegetative propagation of genetically superior trees and protection of planted stock from animal damage are gradually being solved.

The potential for genetic improvement of sugar maple is good. The

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1/Copies of "Proceedings of the Sugar Maple Conference, Houghton, Michigan, August 1968" may be obtained from the NE. Area, State and Private Forestry Service, U. S. Dept. of Agriculture, 6816 Market St., Upper Darby, Pa. 19082.

species has considerable variation in many characteristics. Initial selection work for high sugar-sap has been successful, and reciprocal breeding of these trees is under way. Other critical adaptive responses that are showing up in provenance tests include: time for flushing, onset of dormancy, and potential degree of forking.

Insect enemies of sugar maple are numerous. They contribute mainly to lower quality timber products, and generally have little effect on sap production. However, some insects, such as those that cause repeated defoliation, are potentially serious because they may be partially responsible for maple decline and, consequently, for reduction in sap yields.

Killing types of diseases of sugar maple are rare, but many may be crippling. Fungi that enter through scars, old branch stubs, and frost cracks are a major factor in the 40 percent cull in logs cut for timber products. Also, these fungi--along with insect defoliators and nutritional factors--may be responsible for maple decline.

Present information can be effectively used in managing a sugarbush for better sap production. But as with timber production, wide gaps in our knowledge prevent the most efficient use of this resource, whether it be sap production, timber products, wildlife habitat, or recreation.

However, the conference predicted a bright future for sugar maple, and all products of our valuable sugar maple resource will probably be available to future generations in increasing amounts and quality, provided present and future knowledge is put to use.

NEW RESEARCH FINDINGS AT THE UNIVERSITY OF VERMONT'S PROCTOR MAPLE RESEARCH FARM

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and Mariafranca Morselli, Research Assistant
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The Proctor Maple Research Farm of the University of Vermont's Agricultural Experiment Station has been in operation for 20 years. Its purpose is to serve as a laboratory for basic studies on the biology of the sugar maple and to develop and evaluate new techniques in maple sap production.

We enjoy the active cooperation of the U. S. Forest Service group in Burlington who share with us an interest in the host of problems to be solved.

Through the years, a number of people, both staff and students, have contributed to the program. At present there are four full-time staff, Dr. Mariafranca Morselli, Mr. Fred Laing, Mr. Julius Katz, and myself.

I would like to review some of the highlights of our work, from a topical rather than a project point of view. Some of the work has been published and some has not.

First, basic research on the sap flow mechanisms. From the time of the early settlers, farmers have known that warm days and cold nights in some way are responsible for maple sap flow. Clark in Amherst, Mass., in 1874, and Jones at Vermont in 1903 published the first quantitative data on the phenomenon. In recent years, the work of Stevens and Eggert and Johnson have added to our knowledge, but no clear statement of the processes involved has ever been published.

We know that when a tree warms up after a freeze, sap flow may occur, and if it does, there is no quantitative relationship between the rate of flow and the amount of the temperature rise. A 2-degree rise may give as high a rate of flow as a 10- or 20-degree rise in the tissue temperature. We say the temperature rise is a trigger effect. A second temperature effect appears to be quantitative in that as the temperature falls there is a proportionate decrease in the flow rate. We are studying this relationship in detail.

Any of the living woody tissues of a maple tree show the sap flow phenomena--twigs, stems, and roots. After a flow stops, the vessel sap pressure changes to a vacuum--that is, sap or water is drawn into the vessels if their cut ends are in a sap-filled taphole. This is the period when the sap is drawn up from the roots. What actually happens at the cellular level when a flow occurs? The vessels are long tubes that extend up and down the sapwood and heartwood. The vessels are in contact through their sidewalls with living ray cells and wood parenchyma cells. The mechanisms that are temperature sensitive move water (sap) into and out of the vessels from the adjacent cells.

Several interacting mechanisms are responsible for the movement of water into and out of the vessels. Osmosis is one; the swelling and shrinking of water-holding colloids is another; the hydrolysis of starch to sugars is another; and a direct effect of temperature on membrane permeability is still another. And there may be more that are not identified. All of these processes can be affected by temperature. Contrary to the common concept, it is not necessary to freeze the tissues before a flow can occur. The formation of ice in the tissues is not a part of the flow mechanism. The tissues must be cooled, however. After a previous warm temperature, before another flow can occur, maximum cooling between flows usually means freezing temperatures.

We may now ask what conditions produce the maximum flow. The vessels of the twigs, branches, stem and roots all form an interconnected hydraulic system. These parts may each be under pressure or vacuum. The best flow would occur when these tissues are all being warmed simultaneously. This does not often happen. We have separated the branches from the stem, the stem from the roots, and studied the flow characteristics of the separate parts. A stem and its roots without branches are very sluggish and yield a much reduced volume. Branches and their stem without roots yield two good flows and no more. Roots without stem and branches flow when the soil is warmed, as with a warm rain, but the amounts are small as compared with an intact tree. It is clear from our studies that the biggest flows come from an intact tree and when the entire system is warmed at the same time (twigs, stem, and roots). This information should be useful in predicting the big flows.

In addition to controlling flow rates and volume, temperatures have an important effect on sap and sirup quality. In recent years we have had periods of high air and soil temperatures in mid-season (early April) after the snow cover had melted. In a 48-hour period, the sirup changed from light amber to dark amber, and in a following 48-hour period, back to light amber. These changes appear to be brought about by the effect of temperature on root metabolism. We have changed the composition of the sap by artificially warming the soil around a tree. In one case, this caused an increase in the amino acid content of the sap as measured by the ninhydrin test. We found an unpleasant odor in the boiled sap, and the sirup had a dark color. If we are correct that high soil temperatures reduce quality, this will be of importance in selecting future sites for sugar orchards. The work of Kriebel on sugar sand is of interest here.

We are all familiar with the day-to-day variation in the sugar content of maple sap. Presumably, these changes are controlled by temperature. The reserve carbohydrate in the tree is starch. Years ago Jones showed that the starch content was high in the summer and early fall. Starch decreased in the winter and spring, when the sugar content increased. We have been studying these changes from day to day and at weekly intervals. However, field data from trees are difficult to interpret. Dr. Morselli and Dr. Mathes have been able to grow maple stem and root tissues in the laboratory, and this gives us a system that can be precisely controlled. We have found that in 48 hours, when tissues are cooled from 28 to 6 degrees C., they lose 40 percent of their starch.

What about volume yields? Sugar makers are well aware that individual trees are consistently different in their yields per taphole. We have trees that yield as much as five times the volume of others. In part, this is due to anatomical differences in the stems, but there are no doubt other factors, such as the size and condition of the root system, that are important.

Sirup yields depend upon sugar concentration and volume yield. We have demonstrated from 18 years' data on a group of 29 trees that the sweetest trees are nearly always the same individuals, but also that these same trees have the largest volume yield of sap. In field testing to determine which of a group of trees are superior, volume measurements are very time consuming, but the sugar concentration can be easily and quickly measured with a refractometer.

These relationships are very important for a program of sugar bush management, for it forms an easy and effective basis for selecting the superior trees. My colleague, Mr. Laing, has for several years studied a group of pole-sized young trees. They show more variation in sugar content than do mature trees, but, in general, the same relationships hold. This information should be of great benefit in developing a sugar orchard from a natural stand of young trees.

From a practical point of view, we might ask what are some of the factors that influence taphole yield? Diameter, position, both height and compass direction, and number of tapholes all influence yield. These factors have been discussed for many years by many people and are well known. Other factors are not so well understood. Mr. Laing has for years been interested in the slime plugs that clog the vessels. The material is an amber-colored mucoprotein that is formed in the living ray cells and collects in the vessels. The plugs are a normal part of the aging process in the change from sapwood to heartwood and are, in part, responsible for the reduced flow from heartwood.

Slime plugs are also formed as a result of wounding. They reduce flow in the vessels and also serve as a protective measure against the rapid growth of wood decay fungi. Microorganisms infect tapholes and they too can plug vessels and reduce flow. The paraformaldehyde pellets in general use and other disinfecting agents are effective here. Our work and that of the Forest Service with vacuum pumps indicate that a rather high vacuum increases flow by pulling additional sap from the tree. Finally, we have shown that with plastic tubing the taphole temperatures are higher and the spouts thaw more quickly than do metal spouts.

In conclusion, I would like to say a few words about tubing. We have been experimenting with plastic tubing since 1956. There is no question but that increased yields (over buckets) can be obtained. Beyond this statement there is much confusion. We are convinced that a closed system is superior to a vented system, and that vacuum pumps give an added increase in yield.

We also feel strongly that when a farmer buys tubing, it can lead to a wealth of woe! Each sugar bush is a special situation, and initially a farmer should have the help of someone with a great deal of experience in setting up tubing. In this respect, the County Foresters and County Agents and the people who sell tubing have a very important responsibility. The proper use of tubing and its benefits is the path along which our maple operation can be changed to a flourishing industry.

RESEARCH ON MAPLE SAP PRODUCTION AND MAPLE SIRUP GRADES OF QUEBEC

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For many years the Quebec Department of Agriculture had two maple research stations, one at Plessisville and the other one at Arthabaska, 17 miles apart. These maple stations were, however, small and inadequate for the research program. Last year, the authorities of the Department decided to rent, for a three-year period, a new maple bush for practical research. This maple station offers a possibility of 2500 taps.

The next step in the reorganization of the research facilities will be, as announced by the Minister last spring, the gradual establishment of a few maple farms on government land in the main maple sirup producing regions of Quebec under the direction of a Maple and Honey Research Center. We feel that practical experiments should be continued and intensified, but there is also a great need for basic research, mainly in the field of conservation and chemical analysis of maple products. New markets should be developed for maple products.

Two studies were initiated last spring to compare the efficiency, on ground with very little slope, of "Mapleflo" and "Naturalflow" plastic tubing under a vacuum pumping system. In both cases the quantity of sap collected was higher with the "Naturalflow" system than with the "Mapleflo" system. It appears that the entry of air at the "Mapleflo" taps was partly responsible for these results. The "Mapleflo" tubing was also found to be less resistant to the vacuum pressure than the "Naturalflow" tubing.

In a third study comparing these two systems working by gravity, an identical quantity of sap was collected in each case.

A year and a half ago a new apparatus was designed that could be easily built and handled and was effective for washing the tubing. A few months later, one of Quebec's maple sirup producers built a larger trailer-mounted model. To use this apparatus, the producer has only to roll his plastic tubes on reels corresponding to the dimensions of his bath and to fix them by the center to a shaft driven by a small motor. After a few hours, the tubing is clean and it can be stored on the reels until the following spring.

During the last three years, Quebec has produced very large crops of maple sirup. All this maple sirup is not, of course, retailed by the producers. In fact, it is mainly delivered in bulk to maple cooperatives or dealers. The sirup is graded according to fair standards, and producers obtain a price for it corresponding to its quality. To prevent the sale of adulterated or unsuitable maple sirup, the Quebec Government many years ago passed an act providing that no bulk maple sirup can be sold before it has been graded by Departmental officers. Last spring, eight teams of three men each at different grading stations in the main producing areas graded 23,777,000 pounds of maple sirup.

The grading is done with a new colorimeter made in Quebec and called the C.E.T. electronic photometer. This apparatus is more resistant to shocks and changes in temperature and has a more precise light filter than the E.L. portable colorimeter used for many years. In addition to the readings given of the percentage transmission of light, each grade of sirup is also judged by color standards. This makes the readings much easier for graders to interpret.

All this information is computerized so that data concerning the amounts and grades of sirup sold by our producers to wholesalers are instantly available.

CONTROLLING MICROORGANISMS IN MAPLE SAP WITH ULTRAVIOLET IRRADIATION

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It has long been recognized that the sanitary quality of maple sap is a controlling factor in the manufacture of maple sirup. Maple sap, as it leaves the vessels of the tree, is sterile; but it is readily contaminated by microorganisms introduced during handling and storage prior to atmospheric boiling, causing the sap to be degraded. Fermented sap is the primary cause of dark colored sirup and may produce "off" flavors or poor texture (ropiness) in sirup. The sap producer and evaporator operator have recognized that sap contamination and subsequent microbial fermentation must be controlled to minimize sap spoilage. Without this control, sap cannot be held more than 24 hours.

Physical methods of preventing or controlling microbial growth in sap provide an excellent alternative to the use of additives. Of these, ultraviolet irradiation is best suited for sap preservation. The actinic rays of ultraviolet light have no effect on the flavor or color of sirup made from irradiated sap, and the cost of equipment and power is nominal.

During 1964 and 1965, limited studies were conducted in which sap was stored in tanks and continually irradiated by overhead ultraviolet lamps. Even at depths of 28 inches, the bacterial counts in the sap were maintained below 4.0×10^5 organisms per ml., and after 11 days of storage, a top grade, light amber sirup was produced from this sap. In a comparable sap without the overhead irradiation, uncontrolled growth by adventitious microorganisms during 3 days of storage caused production of sirup at least two grades darker. Laboratory studies were then made to observe the effect of ultraviolet irradiation on bacteria in stored sap under controlled conditions.

The actinic rays from an overhead ultraviolet lamp killed more than 99.9 percent of the bacteria in the top 1/4 inch (surface) layer of sap stored statically at 35°F. The bacterial population at the 1-, 2-, and 3-foot depths was reduced 99, 92, and 75 percent, respectively, at the end of 24 hours, and after 72 hours the population was still reduced 91 percent at the 2-foot level. The samples taken at the 3-foot depth first showed a decrease in bacterial population, and then, after 72 hours, a slight rise. The penetration of the lethal actinic rays of ultraviolet light beyond 1/4 inch diminished with increased depth of sap. The slight decrease in bacterial count at 3 feet indicated that only a limited amount of the actinic rays penetrated to this depth.

While commercially stored sap seldom reaches a temperature of 55°F., a study with sap held at this temperature showed that, during the first 24 hours, the bacterial population decreased by 94, 70, and 15 percent at the 1-, 2-, and 3-foot depths, respectively. Then, a steady and measurable increase in counts occurred. The higher storage temperature increased the irradiation effect, but this was counteracted by a more rapid bacterial growth.

An irradiation study was made in which the surface of stored sap was continuously renewed by recycling at different rates. The greatest decrease in bacterial population, 99 percent at the 3-foot level during the first hour of irradiation, occurred at the most rapid recirculation rate of 1 hour and 20 minutes (time for complete renewal of sap in a 60-gallon tank). Even at a much slower recirculation rate of 4 hours, the population at this level was reduced more than 90 percent after 6 hours. The decrease in bacterial population with the different rates of surface renewal produced a straight-line relationship.

Another study was made to observe the effect of ultraviolet irradiation on recirculated sap stored at temperatures of 35, 45, 55 and 65°F. As in the previous studies, a uniform decrease in bacterial population was noted at each temperature at the 3-foot depth as time of exposure to the irradiation increased. This showed a straight-line relationship when decrease in population vs. time of exposure was plotted on a semi-log graph. The greatest decrease in population was shown to be at the highest temperature (65°F.) and the smallest at the lowest temperature (35°F.). This confirmed the temperature effect noted in the preceding study of the effect of the actinic rays with different rates of surface renewal. The growth rate of the bacteria had little effect on the results because, at the temperatures used, the regeneration times were very long. The decrease in germicidal activity observed at the lower temperatures could be attributed mainly to the decrease in output of lamp energy.

In all the studies, there were significant decreases in bacterial populations after 6 hours of recirculation at all recirculation rates and for all storage temperatures. The decreases at the 3-foot depth after up to 6 hours of recirculation were more than 95 percent for storage temperatures above 35°F.

The control or inhibition of bacterial growth in stored sap, which is a prerequisite for the production of high-quality maple sirup, can be achieved by continually renewing the sap surface by recirculation under ultraviolet irradiation.

The results of this study can be summarized as follows:

1. A method has been developed using ultraviolet irradiation for controlling or reducing the bacterial population of stored maple sap.

2. The bacterial population in sap stored statically at 35°F. can be controlled by ultraviolet irradiation.

3. Ultraviolet irradiation is less effective in controlling bacterial growth in sap stored statically at 55°F. than in sap stored at 35°F.

4. Continuously renewing the surface of sap stored under ultraviolet irradiation gives complete control of the bacterial population of the sap and

is independent of the sap depth and temperature.

5. The effectiveness of ultraviolet irradiation in controlling bacteria in recirculating, stored maple sap increases as the rate of surface renewal increases.

Morning Session, October 9

Chairman: Leland D. Schuler

OHIO'S MAPLE INDUSTRY

Opening Remarks by the Chairman

Leland D. Schuler
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Bill Cowen, our Extension Forester, sends his greetings to all of you. He was very sorry that he could not be here. The Ohio State University has him on a full-time teaching status besides his duties as the only Extension Forester in Ohio. Bill helps all of us a great deal with our maple and forestry problems and with our meetings, and at our festival he judges maple products.

We wish that he could have been here. Since that was not possible, he has written a short summary of our situation in Ohio, and I have a few remarks that I would like to make and then we will get on with the show.

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Ohio is a leading industrial and agricultural production State with a land area of about 26,000,000 acres. Our population is approaching 11 million people. The forest land base is about 6 million acres or approximately 24 percent of the land surface. Four million of these forest acres are located in southern and eastern Ohio. The main centers of maple sirup production, however, are in central and northeastern Ohio -- areas which are being more intensively farmed; are being urbanized; or are in a state of industrial expansion. This area produces over 2/3 of our total crop.

Despite rapid adoption of technological innovations, our production has slipped badly during the past three years, largely because of extremely poor weather during the production season. From a 1962-66 production average of 96,000 gallons of sirup (108,000 in 1964), our production has been down to the following for the past three years:

TABLE I

Maple Sirup Production in Ohio, 1966-68

	Gallons of Sirup	Length of Season	Gallons of Sap per Gallon of Sirup
1966	60,000	27 days	45
1967	69,000	28 days	44
1968	68,000	26 days	44

During the last two years our production has slipped below 100 gallons per farm. In contrast, based on the following Census of Agriculture figures, average production per farm was 125 gallons in 1959 and 142 gallons in 1964:

TABLE II

Ohio Farms in Maple Sirup Production, 1959 and 1964

	Farms Making Maple Sirup	Gallons	Number of Taps
1959	951	119,599	513,960
1964	762	108,000	438,201

During the past three years, our basic problems have been bad weather and lack of labor. Our problems have not been related to production techniques or product price.

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As Bill has told you in his summary, northeastern Ohio is rapidly becoming urbanized; Geauga County is a good example. We always were quite rural. There was not a city in the over 260 square miles of the county. However, we are surrounded by a population of well over 2 million. We are less than 20 miles from Cleveland and are surrounded by Akron, Canton, Painesville, Ashtabula, Warren, and Youngstown. Our county population has increased over 90 percent in the last 15 years.

We produce over 50 percent of all the maple sirup in Ohio. Nearly all of our maple sirup moves into the retail trade, except in years such as 1965.

For years farmers and farm families have left the marketing and merchandising of their products to others. I believe that it is about time we change this. As producers and farmers we become an ever decreasing percentage of the population. We are short on time and labor, and yet our city friends have more and more leisure time and many get in trouble because they don't know what to do with their time.

There must be a principle or a partial answer that we could find and recommend to our industry.

Many of our civic and community groups in Geauga County are already a part of the maple industry. The Chambers of Commerce in Burton and Chardon, the Rotary Clubs, Kiwanis Clubs, schools, churches, fire departments, and many others sell maple products, raise money through pancake, sausage, and maple sirup breakfasts or dinners, or have a part in the Maple Festival in Chardon. There are probably some people in Ohio that do not know about Geauga County maple sirup. We try to involve our people in our Geauga County product.

PREVENTION OF MICROBIAL SPOILAGE OF COMMERCIALLY STORED SAP

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J. R. Sipple and Sons
Bainbridge, N. Y.

In the normal operation of the central evaporator plant, the bulk of the sap processed is purchased. Since sap does not issue from the trees in a steady day-to-day flow, a third or more of the yearly crop may be obtained in a single day. These runs of sap are often too large to be processed immediately, and to expand the evaporation facilities is economically unsound. The sap must, therefore, be held in storage as long as 5 or 6 days. The purchased sap, at the time of delivery to the central plant, usually contains high yeast and bacterial populations, and the growth of these organisms normally continues unchecked in stored sap.

While the use of the germicidal taphole pellets controls, to a great extent, the microbial population in sap as it comes from the tree, their use also maintains sap flows later in the season, complicating the situation since the warmer weather favors bacterial growth and fermentation.

This research was initiated in February 1965, and consisted of two parts: (a) study of means for limiting or preventing sap spoilage (microbial growth in sap) after it has been delivered to, and during its storage at, the central plant, and (b) study dealing with the effect of different types of collecting, hauling, and storage equipment and handling conditions on the growth of microorganisms in sap up to the time of its delivery at the central plant.

For part (a) of this study, four 1000-gallon tanks were installed at the central plant. A large volume of sap, produced under commercial conditions, and delivered to the plant, was pumped into a single storage tank and well mixed. One thousand gallons of this sap was run into each of the four test storage tanks. All four of the tanks were covered to exclude the effect of sunlight. Two of the tanks were equipped with overhead ultraviolet germicidal lamps.

The first, or control, tank contained 1000 gallons of the mixed sap which had not been treated in any way.

The second tank was filled with 1000 gallons of sap that was treated by pumping it in a concentric stream over four 36-inch germicidal lamps. This sap received no further treatment.

The third tank was filled with untreated sap, but was continuously irradiated throughout the storage period with actinic rays from overhead germicidal lamps.

The sap in the fourth tank was irradiated while it was being pumped to the tank by passing it concentrically over four germicidal tubular lamps. Then it was continuously irradiated with actinic rays, throughout the storage period, from overhead germicidal lamps.

These storage studies were repeated three times each sap season. The first storage period was at the beginning of the sap season, the second period was at the middle and third period was near the end.

Sap in the control tank, which received no actinic ray treatment, had a much larger bacterial and yeast count than did any of the irradiated sap, even during the first-run period when the average storage temperatures were the lowest. As expected, from the large microbial count, the sirup made from the control storage tank was of low grade: medium amber for the first run and dark amber for the last run. Sirup made from the sap stored under actinic ray treatment was one or two grades lighter.

The sirups obtained from sap in tanks No. 2, 3, and 4 were of the same grade, but showed noticeable differences in color. Sirup from No. 4 was the lightest, while sirups from No. 3 and 2 were progressively darker but still in the light amber range. The best sirup was made from the sap in tank No. 4 and in each test this was identical to that of sirup made from sap immediately upon delivery to the plant. The sirup from tank No. 3, however, was almost as good.

Even though the temperature of the stored sap increased from early to late in the season, the treatment by the actinic rays was effective in maintaining the quality of the sap throughout the 5 days of storage. The control, or untreated, sap showed the effect of increased microbial growth since the sirup produced was at least one grade darker.

The rates of growth of bacteria in sap stored under the four conditions are typical for any of the three storage periods for each of the three years of this study. In the control, the bacterial population increased at a rapid rate initially and then diminished as the population exceeded 1,000,000 cells per ml. at the end of the 5-day storage period.

Passing the sap in a concentric layer over the four germicidal lamps caused an immediate and pronounced decrease in bacterial cells, followed by a slow but progressive growth in population.

Sap stored under continuous irradiation of the overhead germicidal lamps showed a definite decrease in population during the first part of the storage period, followed by a slight increase.

The combined effect of both the in-line and overhead irradiation of the sap with actinic rays was an immediate decrease in bacterial population due to in-line irradiation and then a very slow increase in population.

Thus the best method of preserving sap for periods up to five days of storage is to irradiate the sap with the in-line germicidal lamps as it is being pumped to the storage tanks, followed by a continuous irradiation of the stored sap with actinic rays of overhead germicidal lamps. The next best treatment is the continuous irradiation of the sap with overhead germicidal lamps if the sap is agitated continuously to bring all of it to the surface eventually. By either of these treatments, sirup made from sap held in storage five days was identical in grade to that made from the sap at time of delivery. It was not down-graded either for off-flavors or darker color.

The second part of this study dealt with the source of microbial contamination prior to its delivery at the evaporator plant. Bacteria and yeast population were measured in sap in the different types of sap collecting and hauling equipment. These measurements were made each day of sap flow for the early, middle, and late runs of the three seasons.

Sap Collected in Plastic Tubing

Only once did the population of the bacteria in sap collected with tubing reach 1,000,000 per ml. and that was for the last run of the 1966 season. At all other times the population of bacteria was low, below 30,000. Because of these low counts, the plastic tubing used to collect and transport the sap to storage tanks (whether roadside or evaporator house tanks) can be considered as an unimportant source of bacteria and yeast contamination.

Except for the third run in 1966 the temperatures appeared to have little effect on the bacterial and yeast populations. However, the results confirm earlier studies that the low counts obviously reflect the germicidal effect of sunlight, since the plastic tubing is transparent to the actinic rays.

Sap from Tanks Supplied from Plastic Tubing

For the three consecutive years, sap from plastic pipelines was stored in three tanks at different locations. The bacterial and yeast populations that developed in the sap in these tanks were recorded each year for the early, middle, and late runs. The sap as supplied to the tanks had a relatively low microbial count in all cases, but during storage there was measurable growth of both bacteria and yeast in the middle- and late-run saps in 1965 and 1966.

The microbial populations of the saps stored in 1967 did not rise as the season progressed, reflecting the lower temperatures of that spring. Only on the last day of the season, when the temperature reached 70°F., was there a pronounced increase in bacterial and yeast populations.

Sap Collected in Buckets

Sap collected in sap buckets had bacterial populations that exceeded 1,000,000 in only one of the nine sap flow periods, and the populations in none of the samples were high enough to cause immediate deterioration of the sap. Since open buckets make contamination by adventitious organisms easy, it was anticipated that the counts would be very high. Good sanitary practices used in the care of the buckets kept the counts low in the sap. However, they were 5 to 10 times that for sap collected in the closed plastic tubing systems.

Sap Stored in Tanks Supplied from Buckets

The bacterial and yeast populations of sap collected from buckets and stored in tanks, either at the roadside or at the evaporator plant, at no time reached populations that would cause serious spoilage of the sap during 1 or 2 days of storage. As would be expected, the bacterial and yeast populations were highest in the sap during the late-season runs.

Sap in Hauling Tanks

Sap hauled in tanks greatly increased in bacteria and yeast population from the time it was loaded into the tanks until it was discharged. This was true whether the tanks were used in the woods or to haul the sap from roadside tanks to storage tanks at the evaporator plant. It was also true irrespective of the sap's previous treatment or storage condition. Undoubtedly the small amount of sap left inside the closed metal tank becomes a rich culture for both yeast and bacteria. Between uses, the tank is warmed from the sun, causing nearly ideal conditions for bacteria and yeast culturing. Thus, any new lot of sap introduced into the tank is cultured and excessive growth starts immediately.

Sap Stored in Commercial Tanks

The sap stored in commercial tanks was a composite of different lots purchased from different producers. It had been subjected to a wide variety of conditions, so that each lot had different bacterial and yeast populations. If sap, when put into the commercial storage, contained less than 10,000 bacteria or yeast cells per ml., and the storage period did not exceed 48 hrs., the sap would yield light amber sirup. If the initial population was above 100,000, the sirup obtained would be of a darker grade, usually medium amber.

Summary

Sap that contains bacterial and yeast populations below 1000 per ml. can be held in storage for 2 days without lowering the grade of sirup produced, provided the temperature of the sap is low, as it normally would be during the early (and often during the middle) run of sap for any sap-flow season.

Sap having an initial high count will ferment if held even one day, and sirup made from it will be dark amber. This is especially true for sap produced during the late or warmer periods of the season.

Sap collected and transported by plastic tubing will have the lowest bacterial and yeast populations, and can be held in storage for a longer time without deterioration. Sap can be stored in open tanks (roadside or inwoods) for relatively short periods (one to two days), whether supplied from buckets or tubing, without reaching dangerous levels of microbial growth.

Sap, irrespective of its source, can be stored up to five days without further deterioration if properly treated with ultraviolet irradiation. It should be exposed to germicidal lamps while it is being pumped into storage tanks and then continuously irradiated with overhead lamps in the tanks. About the same results can be achieved if only the overhead lamps are used and the sap is agitated continuously. The lamps are more effective if the sap is kept cool.

A major cause of microbial contamination occurs while the sap is in the hauling tank. This can be avoided by sanitizing the tank after each use.

NEW DEVELOPMENTS IN NEW YORK'S MAPLE INDUSTRY

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Over the past 100 years, maple production, like agricultural production, in New York has changed both in volume and in location of major producing areas. The trends to larger and more specialized patterns for traditional agriculture and lucrative alternative employment opportunities in most of New York has undoubtedly had its effect on maple sirup production. A recent study, "Maple Sirup Production in New York State," by Lyle Raymond of the Department of Rural Sociology, Cornell (September 1968), points out that in 1875 all of the top ten maple producing towns (in gallons produced) in New York were in eastern counties; in 1964 the western counties show up prominently while production in the eastern end of the northern plateau shows relatively poorly by comparison. St. Lawrence and Jefferson in the north and Delaware and Greene in the south have dropped out of the top ten. Towns in three definite nests of communities have taken their places, led by Lewis and Clinton Counties in the northeast with towns in Chautauqua, Cattaraugus, Wyoming, and Allegany grouping in the west and Chenango and Schoharie Counties in the southeast.

While the general trend in the State has been downward as far as total production in gallons is concerned, several towns have shown as much as 400 percent increase, going from 2,500 to 11,000 gallons per township in one case, over the period from 1875 to 1964.

Some of these areas therefore reflect a greater dependence on maintaining the forest resource than was the case previously. It can, perhaps, reflect the rapid increase in forest land in certain of our agricultural counties. This is particularly true of Allegany which is now 61 percent forested, up from 37 percent in 1950, and Cattaraugus and Chautauqua which are now about 50 percent forested, up from 40 percent, and Chenango 52 percent, up from 38 percent. These are typical counties in which maple production has maintained itself or grown, and they reflect the change to forest from the previously open farm land scene. The figures are substantiated by the 1967 U.S. Forest Service Survey completed for central and western New York. It is estimated that shortly the State will be over 50 percent forested if the trend continues.

In reflecting this change in land use in New York, several programs are being developed which can utilize the maple resource. Two areas of the State are presently seriously concerned with maple production. These are the formally organized Resource Conservation and Development project areas. The first activated project area encompasses seven counties in south central New York of which five are large maple-producing areas. The second area is the three counties of southwest New York, in all of which maple is important. Emphasis is being placed on upgrading maple production in the two regions by their R. C. & D. committees. To produce facts and figures for the feasibility of expansion and to develop a prospectus for potential central evaporator plants, the R. C. & D. unit in south central New York has sponsored a cost account study by the Agricultural Economics Department at the New York State College of Agriculture. Part of the study was completed this past spring; the balance will be done during the producing season of 1969. If the figures developed by this study are favorable, concentrated effort will be expended to increase growth in production. Primary targets for this expansion as set forth by the R. C. & D. committees will be existing producers; if they cannot be motivated, efforts will be made to interest others to take advantage of the existing opportunity.

In northern New York, exploration of renewed uses of natural resource is also being studied. The North Country Economic and Cultural Council, Inc., a private organization, has devoted considerable effort to promoting new ideas and expanding present resource use. Maple production, a viable use of the farm forest in the area, has received considerable attention. Their efforts will be augmented by the study in production and marketing costs developed for the State by the R. C. & D. projects.

With all the promotional work for maple sirup production that is in progress, it could be that we will increase production from the present normal 525,000 gallons to as much as 700,000 in the foreseeable future. Some of our producers have feared that this increase of about 30 percent will cause problems as far as markets are concerned and were against any organized attempts to increase the production. With the lack of production during the last two years, this fear has to a large degree been dispelled. Perhaps reduction of opposition to such an increase is also due to some new approaches to marketing by producers themselves.

Two approaches have been explored:

1. A Maple Bank. The producers in Lewis County, the largest producing area in the State, felt two years ago that some method of "banking"sirup would be a logical arrangement to implement orderly marketing through private enterprise. The approach here was to develop a method of obtaining loans on stored bulk sirup. The reasoning behind this approach was that though there are bumper years there are usually short crops in some sections of the State and/or surrounding States which necessitate purchase of sirup by good marketers nearly

every year. In addition, as marketing techniques throughout the State have become better, more good sirup is moved into retail channels yearly. Therefore, a bank of sirup is a necessity for the good of the industry. To implement such a program, producers in the Lewis County area, the County Extension Agent, and the County Agricultural Stabilization and Conservation Service office manager met to discuss the idea. Later this group recommended that a crop loan program be instituted for maple sirup to operate on the basis that sirup could be stored on the farm or in a central warehouse (therefore allowing for organizations to enter the program). Sirup would be graded and up to 66 percent of the market value be loaned on the sirup at interest rates and formulas similar to those for other agricultural commodities. Time for the loan was to be one year, but the loan would be renewable twice. Sirup is to be graded by the producer for on-the-farm storage loans; the producer was to be free to sell the sirup by private treaty at any time and repay the loan and the interest for the period for which the commodity was stored or banked. This proposal was forwarded to the State Agricultural Stabilization and Conservation Service office which indicated that more than one county should be interested before the program was undertaken. This year a total of 8 of the major producing counties indicated producer support of such a program. However, in view of a curtailed Federal budget, the Agricultural Stabilization and Conservation Service was unable to initiate any new programs and thus did not accept the challenge for this forward step. In looking back on events over the last three years where we had one excellent year with very depressed bulk prices and two years of short crops with good quality sirup practically impossible to get locally at even 36¢ to 45¢ per pound, both New York producers and consumers would have benefited greatly by more orderly marketing methods. It is estimated that in Lewis County alone an additional $30,000 to $75,000 would have been obtained for sirup that normally was sold at buyers'-offer prices over the two-year period. Prices also would not have fluctuated as greatly over the period.

2. Farm Bureau Marketing Program. At about the same time, the New York State Farm Bureau Marketing Cooperative formed a Maple Division to operate on a membership basis to market bulk sirup for the members. This cooperative approach started with 20 members. The approach here was to get good cooperation from the producer without markets as well as those with more markets than production. Bargaining for better prices through direct contact with large bulk buyers was part of the program.

The program really got underway in the short season of 1967 with 60 members. There was considerable juggling of sirup within the State during the immediate post-production period. This year the same short crop situation held with the result that although the Farm Bureau maple marketing program was set up to sell sirup, it is now functioning to buy sirup. The Committee has purchased and distributed to good marketing producers a considerable volume of high-quality sirup. To show the needs for this interchange, there was a need June 1 for a minimum of over 100 drums of No. 1 and "Fancy" sirup by Central New York producers even after an earlier shipment of a carload to the area. This year 130 members were enrolled.

The operations committee of the Farm Bureau's Maple Marketing Division states, "The only problem in the current maple market is the limited supply of commercial grade sirup that should be moved prior to the next marketing season. We have a market available for this sirup provided we can gather sufficient quantity. Our operations committee recommends on the basis of the excellent market developed for fancy grades, that we move the lower grades at reasonable prices in order to put ourselves in the strongest possible marketing position for the coming year." I concur on this position. Under the R. C. & D. program in western New York, the group is exploring the possibilities of developing financing for a cooperative.

Thus, there have been two healthy approaches to bulk marketing in the State with excellent possibilities of success either individually or in combination.

While the acreage of forest is expanding rapidly in the State as previously indicated, much of the growth is either not in the right place or not readily accessible. Therefore, maple producers are doing something about it. They are planting maples.

Years ago in New York there was a law enacted by the State which enabled the landowner to earn credit on his land tax bill for planting trees of approved species along the roads at the rate of 4 trees for a dollar. Approved species were elm, sugar maple, and walnut. The law was in effect shortly after the Civil War. The majority of the trees planted have long since reached maturity; many have fallen to the bulldozers and chain saws and, of course, the law has long since been removed from the books. However, maple producers have reaped a harvest of sap of higher quality and easy access from these trees until highway programs have removed them. Many present-day producers with an eye to the future of the industry have seen the value of trees with large open crowns and widely spaced. Consequently, there has been a trend to plant maples which will lend themselves to the use of modern gathering by tubing. Though most producers would like to take advantage of the new "sweet tree" program results of the Burlington office of the U.S.F.S., they feel that they must get on with the job of planting as fast as possible to counter the rapid elimination of open and roadside maples so readily accessible.

For the most part, the number planted per acre has generally been set at 100 (about a 20-foot spacing). This is more than enough for the ultimate in sugar bush, but enough to be operable when the trees are 10-15 inches in diameter. In planting, the usual size tree has been from 1/2 to 1-1/2 inches in diameter at the ground level. The reason for such a choice is to get trees above the deer line and large enough to respond to good growing conditions. Each tree has been a natural tree lifted from a thicket where the plants are too close or otherwise inaccessible. Each has been given a rather drastic pruning to balance top with roots. When an adequate job of watering has been done, survival has been nearly 100 percent.

Fertilizing has been recommended, especially since there are now packeted fertilizers available. One such fertilizer (16-8-16) is available in 2-oz. packets. Several producers have used these or regular 15-15-15 fertilizer on planted trees with visibly good results. The packeted fertilizers are generally supposed to be available to the tree for two or more years and give the tree an extra boost over a long period.

Needless to say, the fact that fertilizer has given good results with planted trees has stimulated interest in application of fertilizer to sugar bushes. It appears that much more research on the use of fertilizer in sugar bush management must be done in the near future to determine the rates and economics of such applications in relation to the sap production. One applied research area in Lewis County has had excellent results which were reported in the Natural Maple Syrup Digest about a year ago. It is quite probable that, although our maples have gotten along for years without added fertility in the woods, some mineral fertilizer may possibly be able to improve production, and consequently profits, to keep up with modern sugar house techniques.

PROMOTION OF VERMONT'S MAPLE SIRUP INDUSTRY

Raymond T. Foulds, Jr.
Extension Forester, University of Vermont
Burlington, Vt.

Abstract

Our source of maple knowledge in Vermont has come over a period of many years, as it has in some other States like New York, from the earliest discoveries of the Indians and the French soldiers. The latter used to make a whole year's supply of maple sugar and store it in wooden barrels. Later the early Vermonters did the same. Later still they sold their surplus to others, and the Vermont maple industry was born.

Vermont's reputation for maple, I believe, has come mainly from the production of a quality product. Quantity is also important -- the Vermont production is one-third of the total U. S. production. The State has also been the home of four large packers, namely, United Maple, American Maple, Cary Maple, and Coombs Maple Products.

Vermont is approximately 6,000,000 acres in size. Of this, 71 percent is woodland. In this woodland, 1,500 sugar makers tap about 2,000,000 maple trees. Formerly (1927) the sugar makers made 10-1/2 million pounds (950,000 gallons) of sirup yearly. Today they make about 4-1/2 million pounds (400,000 gallons) of sirup.

The price of sirup in Vermont has gone up slowly since 1956, and in 1968 reached the highest ever: $5.38 per gallon at the farm. The value of Vermont sirup sales to sugar makers is about $2,225,000 annually. Unlike many other states, Vermont sells only 42 percent of its sirup at retail. In addition, 14 percent is sold at wholesale to retailers. The balance of 44 percent is sold in drums as bulk sirup.

Vermont's activities in promoting the sale of maple products includes efforts of the Vermont Maple Sugar Makers Association, which has been promoting the industry since 1880. The Association sells and promotes Vermont Maple Products at the Eastern States Exposition in West Springfield, Massachusetts,

each year. It also holds educational meetings, including the State-wide Maplerama in cooperation with the Extension Service, University of Vermont, and the local County Associations. It has 350 members.

The Vermont Maple Industry Council, organized in 1956, seeks to solve problems of the Vermont industry. It has 24 members representing 10 categories of the Vermont industry. Robert G. Coombs, Jr., is Chairman, and I have the honor of being Secretary.

The State has a Maple Market Development Project financed by State and Federal funds. Everett Willard is the project director. He works for the Vermont Department of Agriculture. Another effort helping to promote the Vermont industry is the State's compulsory grading law which was enacted in 1949. It has also enjoyed the results of research conducted by the Agricultural Experiment Station since the 1880's, the U. S. Forest Service since 1963, and the Agricultural Research Service since 1952.

Three active county organizations (in Rutland, Caledonia, and Franklin Counties) have helped to promote the industry locally.

A marketing cooperative organized in 1965 has had three successful years, and is paying a drum price to its members of about 3¢ per pound higher than most other buyers. In 1967 it sold $33,000 worth of sirup. It needs more members, better financing, and a full-time manager.

MAPLE PRODUCTS PROMOTION - SOMERSET COUNTY (PA.) STYLE

James A. Bochy
County Agricultural Agent
Somerset, Pa.

Abstract

An Extension Service Agent is an organizer of learning activities for his county clientele. In addition to informal educational programs designed to enhance the agricultural production skills and the abundant living features of his county residents, an Extension Agent also becomes involved in consumer education activities. And when a county enjoys a proud maple heritage, consumers within and outside the county borders must be exposed to the mystery and romance of maple sirup.

Somerset County is located in southwestern Pennsylvania, far to the south of normal producing areas. Topography and climate are conducive to fine natural stands of sugar maple trees. The geography of remoteness in relationship to other producing areas would lead one to surmise that a captive market for maple products might exist in the Somerset area which includes Pittsburgh, Johnstown, and Altoona, Pa., Cumberland, Md., and Washington, D. C. But actually in the post-World War II era, the industry was characterized by chronic overproduction, large quantities of drum sirup for export and low, low

prices. The industry was depressed and woodlots were being cut.

In the late 40's, new technology began to emerge from the Maple Investigations Unit of the Agricultural Research Service facility at Philadelphia. Extension foresters and county agents organized educational programs to take advantage of research findings everywhere and from this series of meetings emerged the Somerset County Maple Producers' Association. This group is dedicated to more efficient production and greater promotional efforts.

In 1948, the seeds of a major promotion were planted and after twenty years of unparalleled success, the Somerset County Maple Festival has grown to the point where it taxes the physical and human resources of Meyersdale, a town with a population of 5,000. Soon afterward, service clubs, church organizations and other groups and individuals were caught up in the spirit of local product promotion and it became a countywide effort. Everyone soon realized the tourist dollar value of maple promotions and the list of promotional efforts multiplied.

Promotional Highlights

... The Maple Festival with its Queen Contest is the keystone event in the overall effort. Queen used extensively.

... The Maple Producers' Association added a "Maple King" feature for the outstanding producer in the Maple Products Contest and a "champion sirup award" for the best sirup sample.

... The maple tree tapping ceremony heralds the opening of the maple season with bands, pageantry and guest dignitaries.

... Maple cookery schools are held for local producers and others.

... Educational meetings feature marketing items for producer benefit. 4-H Clubs become involved.

... Maple museums provide focal points for tourist interest.

... Programs for news media receive a very generous response.

... Programs for service clubs, granges, etc., are always in demand.

... Product samples are furnished for banquets, visiting dignitaries, special events, conventions, etc.

... Cooperation with State Bureau of Markets and other promotional groups receiveshigh priority.

... Greater participation in the State Farm Show program is encouraged.

... The local group cooperates with State Maple Syrup Council in publishing literature, post cards, and exhibits.

... Tours to maple camps and central evaporators are encouraged by the Festival, Maple Producers' Association and others.

... The Extension Office organizes people power for effective promotional efforts - example, programs and demonstrations for public viewing.

(A demonstration featuring antique maple equipment was presented by the author.)

Once again, an Extension Agent is an organizer of learning activities using the resources available to him. With a little effort, ingenuity and enthusiasm, all of us can contribute to the promotion of Mother Nature's sweetest and rarest product. As individuals, we can contribute a limited amount, but we must organize the resources available in our own counties and thereby multiply our efforts for a broader and more effective promotional program.

Afternoon Session, October 9

Chairman: Marvin E. Smith

TRENDS AND DEVELOPMENTS IN MINNESOTA'S MAPLE SIRUP INDUSTRY

Opening Remarks by the Chairman

Marvin E. Smith
Extension Forester, University of Minnesota
St. Paul, Minn.

On this occasion three years ago I stated that efforts to get more of Minnesota's sugar maple resource tapped for the production of maple sirup were being projected over the long term; that it was not realistic to expect that we could achieve the educational objectives with hurried crash programs; that solid and lasting gains in terms of an expanded maple industry would be achieved only to the degree that the various agencies and organizations most directly concerned were willing to cooperate and become involved in informational and educational programs geared to the special needs and interests of the maple producer.

Viewed in this context, it appears to me that these remarks on developments in Minnesota since 1965 are similar to reporting progress of a football team immediately after the opening kickoff, when the ball still is in the air. If we pursue this analogy, I might add that we are in good physical condition, we progressed well in practice, we sharpened our skills in the exhibition games, we have a game plan, and we have lots of confidence that the game is ours to win.

Now, I would like to point to the following items which emerge as some of the highlights in our extension program in maple since 1965.

The interest shown by a younger clientele for opportunities in the maple industry is very encouraging. This is particularly evident at our annual Maple Sirup Institutes where we have the best opportunity to size up the people we are reaching, and to determine what the potential may be for those coming into the maple industry.

Increased production will be achieved with the expansion and modernization of existing plants and with the additional sugar bush stands brought into production by new producers. Modest gains are being made on both fronts. One instance of new plant establishment is a family-operated sugar house which was operated for the first time in 1968. It incorporates most major advances in present maple technology, and some other refinements where the owner's ingenuity deserves all the credit. Three to four thousand trees in a 40-acre woodland furnished all the sap processed in a 6- by 18-foot oil-fired evaporator. If the owner should decide to expand into central sap evaporation, another evaporator could be installed in space already provided in the original design.

The year 1966 was a banner year for sap yields, and sirup production in the State hit 12,000 gallons, well above the previous 5-year average of 7,000 gallons. It was the largest crop of any year since 1953. To observe that the 1962 sirup crop was 9,000 gallons in a sap season comparable to 1966 suggests that modernization and expansion over recent years were key factors accounting for the production increase. It suggests also that we may be on the threshold of reversing a historical decline in maple production.

Three years ago a number of Minnesota sirup makers and the Extension Foresters shared a conviction that producers should form a State association to represent the industry in programs geared to market promotion, consumer education, and support of research and development. As some of you know, the organization was since formed under the name Minnesota Maple Syrup Producers Association, and became an affiliate of the National Maple Syrup Council. In its short history, the organization has achieved some successes. Not the least of its accomplishments is a growing sense of cohesion among producers, and the awareness that rugged individualism helps less to solve problems than to cause them in today's complex society.

A State fair display and retail sales emphasizing a consumer education theme and a sales and demonstration booth at the Northwest Builders' Show were major projects of the Association in each of the past two years.

MAPLE SIRUP PRODUCTION AND PROMOTION IN VERMONT'S TOURIST AREA

Robert Coombs
Proprietor, Beaver Brook Sugar House
Chairman, Vermont Maple Industry Council
Jacksonville, Vt.

Our small portion of the maple business started in 1960 with the purchase of the Beaver Brook Sugar House at Wilmington, Vt. This was our first experience in making maple sirup. We continued to use the equipment already there. This consisted of a 6- by 18-foot wood-burning evaporator and a 4- by 16-foot high pressure steam pan. We boiled sap for 14 consecutive days, from April 2 to 16. The season started late and was short and sweet. Sap was purchased from 4400 buckets, which made 1200 gallons of sirup.

As soon as the wood pile was gone and the season was over, we sold the wood-burning evaporator. Realizing the wood created a problem within the sugar house, we wasted no time installing our first direct oil preheating evaporator. This was so successful that in 1963 a second direct oil preheating evaporator was installed.

Now with the two direct oil preheating evaporators and the high-pressure steam finishing pan which is fired by a 100-horsepower steam generator we can evaporate 875 gallons of sap per hour. This makes an average production of maple sirup of 20-23 gallons per hour, depending on the quality of sap available. The three evaporators burn 60 gallons of oil per hour.

In 1966, which was our best season, we had the sap from 25,000 taps. Sap was bought from 15,000 taps and the remaining 10,000 taps were our own buckets.

Almost all the sap has to be taken to the sugar house in tank trucks. About half of the sap is delivered to us by the farmers. The remainder is picked up by our truck.

The sap is dumped into our calibrated measuring tank, where volume is recorded and sugar content is measured. From there it is drawn by gravity to the bulk storage in the basement. Storage capacity in the sugar house totals about 18,000 gallons, most of which is covered by germicidal lamps. These have proved very beneficial in retarding the growth of bacteria in the sap.

An electric control switch activates a pump, which brings the sap from the bulk storage to an elevated tank. The sap is fed from this tank to the evaporators by gravity.

Each of the three evaporators has its own float level control, so if there is an obstruction on the flow of sap to any one evaporator, the next one in the series can pick up fresh sap. The two direct oil evaporators each have a low-water cut-out, so that if the sap level gets below a desired point, the oil burners under that pan will be cut off. This has saved our pans several times.

We usually finish all our sirup in the steam pan, as the temperature of the steam heat does not go above 350°F. This eliminates any danger of burning either the pans or the sirup.

An automatic draw-off is used on the steam pan to aid us in the removal of the sirup. Last sugaring season we had an automatic draw-off control made here in Philadelphia by the Eastern Utilization Research Laboratory. Dr. Willits brought this control up so that we might experiment with it. The biggest advantage in this control is that it compensates for atmospheric pressure change. The control worked very well, but the draw-off accompanying it was 1/2-inch pipe size and this did not allow for the flow of sirup that the evaporator was capable of making.

A pressure filter is used in the final process for clarification of the sirup. During the sugaring season, as many as 2000 people a day visit our plant. Each may sample the maple sirup. We feel this helps promote sales.

The steam billowing from the cupola can be seen for a half mile in three directions. A sugar house located on a main road certainly has a big advantage. Our sugar house is open year round. Numbered signs tell visitors the steps in sirup making. The equipment is identified by signs also. Many antique sugaring tools are displayed.

By a strange coincidence, all visitors must pass through the gift shop before entering the sugar house. Maple products are our largest sales item, but we feature many of Vermont's native products. These include Vermont cheese, Vermont honey, Bennington pottery and Vermont woodenware, to name just a few. Seasonal items, such as Vermont apples and cider, make added interest and sales.

Sugaring time and fall foliage season are by far the best as far as sales are concerned. However, our summer tourist season and our 16-week winter ski season add greatly to the desirability of our location.

The maple sirup we produce at Beaver Brook Sugar House is put into drums and sold to Coombs Maple Products, Inc. at Jacksonville, Vt.

My father and mother started the business of packaging maple products in 1925. During this period of 43 years, the business has grown until we are one of the largest packers of pure maple products in Vermont. I have worked with them in the business for 21 years and have been a partner since it was incorporated in 1962. My mother who has run the business for the past four years is a very capable manager and keeps us all headed in the right direction. We have eight year-round employees and during the summer and fall go as high as 16.

Most of our sirup is bought in the month of May and is packaged and distributed throughout the entire year. We have about 500 wholesale customers in the eastern New York and New England areas who use our maple products. Our sales have been developed to spread our candy production out for as long a season as possible. In the spring there are those that come to see sugaring. In the summer there are our vacation tourists. In the fall there are people who come to view the foliage and visit the large fruit farms that are at the peak of their sales in September and October. Then there is the long winter ski season. All these events combine to keep us busy the year round making fine maple products available to the consumer.

PROMOTION OF THE MAPLE INDUSTRY IN WISCONSIN BY THE WISCONSIN MAPLE PRODUCERS COUNCIL

Adin Reynolds
Secretary Treasurer, Wisconsin Maple Producers Council, Inc.
Aniwa, Wis.

To describe "Promotion of Maple Syrup in Wisconsin" is quite a challenge because it would seem that anything I could say has been said before. Anything we are doing, very likely, has been done before. So the challenge is to say these same things in a different way and make you think you have heard something new. That would be a neat trick if I <u>only</u> had the talent.

The primary purpose and real value of such a conference as we have here today is to share our knowledge, current data, and new developments within the industry, and yet the most important and key benefit you could take home with you would be new and better ideas in marketing, and this key thing is something that some sirup makers are most reluctant to share. If you have some gimmick that is really selling your sirup, chances are that it is still depending on some type of promotion. Now I don't believe Wisconsin has any special gimmicks, but we do sell far more maple sirup than we are presently producing, and each year the demand is increasing. Each year we are importing more sirup from other States and we are now reaching into Canada for additional supply. So something <u>is</u> selling maple sirup in Wisconsin.

If we can use the calendar year as an outline, our first step in promotion would be our series of Maple Institutes. These are held in January, and as we have divided our State into ten maple districts, usually at least ten institutes are scheduled. We hold these meetings in January because that is the month we have that nice balmy weather--no snow and it's so nice to get around. We often have had a guest speaker from this Laboratory with us at these institutes and they could add more to my comments on Wisconsin weather and roads in January. By the way, you will notice that we call our maple meetings Maple Institutes in Wisconsin, whereas other States call theirs Maple School. Basically they are the same, but we don't call ours "schools" because we have quite a lot of backward folks like myself in Wisconsin and we didn't do too well in school. So if we called these Maple Schools it might frighten most people away. So they are called institutes. None of us sirup makers in Wisconsin know what institute means, so we all come to the meetings out of curiosity and we get a pretty good turnout this way. These meetings are not promotional in themselves, but in addition to the Statewide publicity given them, a part of each program includes the making of plans for the year's activities. New ideas and suggestions are solicited. Committees are set up to handle the season's work.

At these institutes we try to get local Maple Queen contests in motion in each of the districts so that they can have a final selection to send to the Statewide contest held later in May. This creates interest in these various areas, and maple sirup is the product that is talked up in the local papers and on local radio and television programs.

Also in January we hold our annual Wisconsin Maple Producers Council meeting which is attended by delegates from each of these districts. Again, there are notices and publicity throughout the State calling attention to these meetings and to maple sirup.

Next we approach our Governor with a request to proclaim the first full week in April as Wisconsin Maple Sirup Week. As you know, anything that our Governors do or don't do is given plenty of publicity, so we feel this proclamation with all the attention given it by the press and other news media is excellent promotion. The signing of this document is witnessed by a member of the industry together with our current Maple Queen, the event is photographed, and these pictures get Statewide space in newspapers and on television.

The next step is participation in the National Maple Queen Contest. This usually takes place in early April, and Wisconsin has had an entry in the last three contests - two of them held at Chardon, Ohio, and the last one in 1968 at Vermontville, Michigan. At this 1968 contest, our Wisconsin Maple Queen, Miss Leila Hagen, was the winner and was crowned by the very lovely retiring queen of New York. Now the State and National Queen contests are 100 percent promotional events, and although it may be difficult to place a true value on these things, I do believe this value to be at a pretty high level. Publicity starts back in each of our ten districts as local interest and contests develop. The press, the radio and television all take a part in each of the local contests and this kind of publicity is carried through the finals where a State winner is chosen. Then winning national honors commands more public attention, at least in the winner's home State. Remember, everyone of these events or activities is directly spotlighting maple sirup. Our Maple Queen is continually invited to appear at various events and parades throughout Wisconsin; in fact, we are able to meet only part of these requests.

The next step is our Wisconsin Maple Festival. It is not patterned after any other Maple Festival that I have attended as we try to focus main attention on maple sirup. We do this with two features. One is a mammoth pancake and maple sirup feast continuing all day and the other is a Statewide maple sirup quality judging contest. The big pancake feast, which I reported on a few years ago, has become quite an attraction. The festival is held at our maple sirup plant about two miles from our little town of Aniwa, where it has been held for the last 18 years. Geographically, we are not located near any metropolitan areas or highly populated sections but we do draw a few thousand people, some chartering busses out of Milwaukee while others come from Chicago and the Twin Cities, and others come by plane. We erect large tents, one is 40 by 120 feet (the eating tent) and others are used for entertainment and exhibits. We arrange for good television entertainers, square dancing, horse-pulling contests, food demonstrations, Indian crafts, and a featured speaker. Some years we have our Governor, and at least one year it was none other than Dr. Willits from this Laboratory. The sirup-judging feature attracts sirup makers and their families from many parts of the State, and this sort of contest is very educational, both for the producers who send in entries and for the thousands of consumers who see and learn how sirup is graded. The entries are all on exhibit, and an information chart shows the points of quality. The entries in the top class are later exhibited at our Wisconsin State Fair. Another feature of the festival is the final selection of the new Wisconsin Maple Queen, who is crowned by the outgoing queen. This part of the program is enjoyed by many of the day's visitors.

Now to move on to our next promotional activity, we go to the Wisconsin State Fair, and here we have an exhibit that we think is one of the greatest. To briefly describe it, we have been alloted a space close to 100 feet long and about 40 feet wide in one of the largest buildings on the fair grounds. It is an island display which fair-goers can walk completely around. At one end they see a "maple forest" -- real maple trees, full size, and reaching to the roof structure before tops are cut off. These woods are enclosed with an old-fashioned rail fence, and among the trees is natural litter -- leaves, brush, and snow. (The snow is "State Fair snow" and doesn't melt.) The trees are all tapped and are dripping sap -- "State Fair sap," of course. Few people question this sap flow in August, and even some taste and believe it to be sweet. All types of collection equipment from the early hollowed wooden troughs through the different buckets to tubing and plastic bags are in use here. You would even find a few squirrels in this area. Next you would see a beautiful handmade log cabin, every log axe-notched to fit so perfectly that no space is seen between the logs. The building is complete in every detail -- even with roof shingled with genuine hand-split cedar shakes. This log cabin is the evaporator house, complete with a working model evaporator boiling "State Fair Sap." "Sirup" is shown coming out of a draw-off and filtered. Steam is floating upward and around and carries a maple aroma throughout much of the building. We don't tell people that this maple "smell" is anything but genuine, and few people even question it. We try to have a man "attending" the evaporator and answering the thousands of questions put to him. Another log cabin is next, equally well made and perfect in detail, and this is the "candy kitchen." Here the bottling and canning of sirup is shown together with maple sugar candy being made continuously throughout every day of the fair. Here, too, the boiling sirup reaching the candy stage sends out a true maple aroma and tempts the appetites of hundreds of people watching the process. Following this is another hand-hewn log enclosure that serves as a sales counter where this freshly made candy is sold along with all maple products packed in every kind of container. We feature the serving of a pure maple sundae which introduces people to maple sirup and shows another way in which it can be used.

Next is a display or exhibit of the winning entries of maple sirup that were selected in the judging back in May at the Wisconsin State Maple Festival. The names of the producers are shown here, too, and these are proudly viewed by the producers attending the fair as well as being seen by the many thousands of fair visitors. Information plaques are posted throughout the exhibit for the benefit of many fair-goers unfamiliar with the maple industry.

We feel proud of this exhibit and we believe it is one of our best promotion efforts. By far the most credit for this outstanding exhibit must go to our Wisconsin Extension Forester, Ted Peterson.

The Wisconsin State Fair topped the million mark in attendance this year and so a great many people, potential customers, were exposed to maple sirup at this fair. I might add that we feature our Maple Queen at various events during the fair too.

Another event, somewhat similar to the fair, is in progress right at this time in Madison. This is known as The World Food Exposition and here, too, we have a moderate size exhibit and again our Wisconsin maple products are presented for sale to the thousands of visitors.

These various activities, together with limited direct advertising in newspapers and radio and television are the sum of our total promotional efforts.

THE PARTIAL CONCENTRATION OF MAPLE SAP BY REVERSE OSMOSIS

J. C. Underwood
Chemist, Maple Investigations
Eastern Utilization Research and Development Division, ARS, USDA
Philadelphia, Pa.

Since the last maple conference in 1965, we here at EURDD have been working on a new process for concentrating maple sap involving the principle of osmosis. Actually, this well-known phenomenon is being applied to the removal of water from many dilute water solutions in the reverse, and the mechanism is called reverse osmosis. A simple definition of reverse osmosis would be "pressure filtration using a membrane which allows only the passage of water."

Laboratory studies in late 1965 and early 1966 showed that the reverse osmosis process could be effectively used to concentrate maple sap. The studies indicated that (a) the maple flavor precursors did not pass through the cellulose acetate semipermeable membrane, but were retained unchanged in the sap concentrate, (b) up to 75 percent of the sap water could be efficiently removed, and (c) the removal of the remainder of the water could be done by the conventional heat process to produce a full-flavored typical maple sirup.

Based on these data, a small plant-size reverse osmosis concentrator was constructed during 1967. Called the EUROC, this unit is 12 feet long, 4 feet wide, and 5 feet high with eight pressure vessels (each 10 feet long by 4 inches in diameter). Each vessel contains nine standard 1-foot spirally wound reverse osmosis modules. Each module is about 11 square feet of membrane, providing a total of 800 square feet of modified cellulose acetate membrane for this unit. After tests here at the laboratory showed that mechanical operation of the unit was satisfactory, the EUROC was moved to the central maple sap evaporator plant of J. L. Sipple and Son, Bainbridge, N. Y., for field testing during the 1968 maple season.

The paramount factor that had to be established at the maple sirup plant was whether or not the concentrated sap from the EUROC would yield a good product when finished to sirup by conventional open-pan atmospheric evaporators. From a uniformly mixed 4000 gallons of stored maple sap, 500 gallons were pumped through the EUROC at 600 p.s.i.g. at a feed rate of 5 gallons per minute. This removed 2.5 gallons of water per minute from the sap, and these conditions were found to be optimum for operation of the unit. The concentrated sap was then boiled to sirup density in the Sipple commercial maple sap evaporator pans. The sirup thus produced could not be distinguished from sirup made from the remainder of the sap by the usual procedure. Analysis of the "pure" water or permeate from the maple sap processing showed that the sugar lost from the sap averaged 1 part in 500. Ten thousand gallons of sap were handled by the EUROC during the 1968 season with no trouble.

Information on the cost of this operation is limited. No data are available on the life of reverse osmosis membranes or on the cost of a commercially built EUROC. At this time the cost of a unit the size we have described should be less than $20,000. Therefore, cost data are limited to the energy cost of the removal of water from the maple sap by reverse osmosis and atmospheric boiling. This is summarized as follows:

		Cents
A.	Removal of 1 gallon of water	
	By reverse osmosis (electricity)	0.06
	By thermal distillation (oil fuel)	1.50
B.	Concentration 2.5° Brix sap to sirup (gallon)	
	Thermal distillation (oil)	49.8
	Combination	
	55% RO	1.1
	45% distillation	22.4
	This is a saving of 54%	23.5

In conclusion, the reverse osmosis process is applicable to the concentration of maple sap, but at present the capital investment for the equipment is high. Although a unit the size we have would cost close to $20,000, many things will happen to lower costs. For example, since these experiments were run this spring, General Atomic Division, Gulf Oil Corporation, has developed improved modules which we have found to give a 50 percent increased water removal. This would increase the capacity of our plant to 450 gallons of sap per hour. So we feel that reverse osmosis will become economically feasible for the maple industry and many other processes.

Reverse osmosis units could also be feasible for the removal of water at production sites so as to make economical the hauling of sap longer distances to centralized plants.

Problems yet to be resolved before we can fully recommend commercial use of reverse osmosis are the life of the module membranes and the means of preserving the membranes between seasons and between intermittent periods of use.

LIST OF ATTENDANCE

Name	Organization	Address
Andersen, A., Jr.		Long Eddy, N. Y.
Andersen, Mrs. A., Jr.		Long Eddy, N. Y.
Austin, H.	Vermont Evaporator Company	Ogdensburg, N. Y.
Baltus, J.		Wasau, Wis.
Bascom, K. E.	New Hampshire Maple Producers Assoc.	Alstead, N. H.
Bell, R.	Eastern Util. Res. & Dev. Div.	Wyndmoor, Pa.
Bochy, J.	Agricultural Extension Agent	Somerset, Pa.
Boelter, A. H.	Michigan Dept. of Conservation	Lansing, Mich.
Brookman, G.		South Dayton, N. Y.
Brookman, Mrs. G.		South Dayton, N. Y.
Brown, L. C.	Leader Evaporator Company, Inc.	Williston, Vt.
Burns, W.	The Quaker Oats Company	Barrington, Ill.
Carpenter, L.	Sugar Bush Supplies Company	Lansing, Mich.
Coleman, J. D.	United Maple Prod. Ltd.	Delta, Ont., Canada
Connolly T.		Zanesfield, Ohio
Connolly, Mrs. T.		Zanesfield, Ohio
Connolly, W.	Connolly Farms	Springfield, Ohio
Connolly, Mrs. W.		Springfield, Ohio
Cooler, F. W.	Virginia Polytechnic Institute	Blacksburg, Va.
Coombs, R.	Coombs Maple Products	Jacksonville, Vt.
Coombs, Mrs. R.		Jacksonville, Vt.
Corbett, C.	Ontario Maple Producers Assoc.	Lucan, Ont., Canada
Crofts, W.		Haliburton, Ont., Canada
Crofts, Mrs. W.		Haliburton, Ont., Canada
Curtis, E.	National Maple Council	Honesdale, Pa.
Curtis, Mrs. E.		Honesdale, Pa.
Daggy, E. E.	Corn Products Company	Bayonne, N. J.
Davenport, R.		Shelburne Falls, Mass.
Davenport, Mrs. R.		Shelburne Falls, Mass.
Dayton, H.		Stamford, N. Y.
DeGroat, A.	Prospect Enterprises	Stamford, N. Y.
Diamond, R.		Jefferson, N. Y.
Diamond, Mrs. R.		Jefferson, N. Y.
Dryden, E. C.	Eastern Util. Res. & Dev. Div.	Wyndmoor, Pa.
Evans, M. A.	Pa. Crop Reporting Service	Harrisburg, Pa.
Farley, H.		Middlefield, Ohio
Farrand, E. P.	The Pa. State University	University Park, Pa.
Fluke, W. J.	Pa. Crop Reporting Service	Harrisburg, Pa.
Flynn, C.	HCA Food Corporation	Brooklyn, N. Y.
Foulds, R. T., Jr.	University of Vermont	Burlington, Vt.

Name	Organization	Address
Gale, R.	Pa. Dept. of Forests & Waters	Harrisburg, Pa.
Gibbs, C. B.	Northeastern Forest Expt. Station	Burlington, Vt.
Gowen, G. H.	Tamarack Farm	Alstead, N. H.
Gowen, Mrs. G. H.	Tamarack Farm	Alstead, N. H.
Grasser, G.	Mountain Meadow Farms	Shellsburg, Pa.
Grasser, Mrs. G.		Shellsburg, Pa.
Guilbault, J.	Canada Dept. of Agriculture	Quebec, Canada
Hall, H. D.		Somerset, Pa.
Hall, Mrs. H. D.		Somerset, Pa.
Hansen, L.		Cherry Valley, N. Y.
Harding, T. R.		Athens, Maine
Harding, Mrs. T. R.		Athens, Maine
Harley, J. C.	R. J. Reynolds Foods, Inc.	New York, N. Y.
Heller, E. L.	Gulf General Atomic	Washington, D. C.
Hevener, H.		Monterey, Va.
Highlands, M. E.	University of Maine	Orono, Maine
Hogan, J. M.	University of Maine	Orono, Maine
Huxtable, R. B.	Sugar Bush Supplies Company	Lansing, Mich.
Humphreys, W. A.	Ontario Dept. of Agriculture	Barrie, Ont., Canada
Hunt, C.	U. S. Forest Service	Upper Darby, Pa.
Ingram, S. P., Jr.	Consumer & Marketing Service, USDA	Washington, D. C.
Johnson, A. R.	Food & Drug Administration, HEW	Washington, D. C.
Johnson, T. L.	Ohio Dept. of Natural Resources	Burton, Ohio
Johnson, Mrs. T. L.		Burton, Ohio
Jones, A. R. C.	Macdonald College	Montreal, Que., Canada
Kidd, W. E., Jr.	West Virginia University	Morgantown, W. Va.
Kissinger, J. C.	Eastern Util. Res. & Dev. Div.	Wyndmoor, Pa.
Kissinger, Mrs. J. C.		Wyndmoor, Pa.
Koelling, M. M.	Michigan State University	East Lansing, Mich.
Krider, M. M.	Eastern Util. Res. & Dev. Div.	Wyndmoor, Pa.
Kruggel, P. W.		Litchfield, Ohio
Kruggel, Mrs. P. W.		Litchfield, Ohio
Laing, F. M.	University of Vermont	Burlington, Vt.
Lamb, R. M.		Baldwinsville, N. Y.
Landry, C. E.	Les Producteures de Sucre d'Erable du Quebec.	Plessisville, Que., Canada
Lewis, A. S.	General Foods	Dover, Del.
Lesure, L. B.		Ashfield, Mass.
Lesure, Mrs. L. B.		Ashfield, Mass.
MacArthur, J. D.	Macdonald College	Montreal, Que., Canada

Name	Organization	Address
McConnell, R. B.		Coudersport, Pa.
Manula, H.		Glen Flora, Wis.
Manula, Mrs. H.		Glen Flora, Wis.
Marvin, J. W.	University of Vermont	Burlington, Vt.
Merrilees, D.	Norwich University	Northfield, Vt.
Moore, F.		Ocqueoc, Mich.
Moore, Mrs. F.		Ocqueoc, Mich.
Moore, R. L.	G. H. Grimm Company	Rutland, Vt.
Morrow, R. R., Jr.	Cornell University	Ithaca, N. Y.
Morselli, M. F.	University of Vermont	Burlington, Vt.
Newton, D. A.	R. J. Reynolds Tobacco Company	Winston-Salem, N. C.
		St. Emile de Mont-calm, P. Q., Canada
Pankey, R.	The Quaker Oats Company	Barrington, Ill.
Peterson, T. A.	University of Wisconsin	Madison, Wis.
Petren, S. J.	Valhalla Farms	Glencoe, Pa.
Ratchford, W. P.	Eastern Util. Res. & Dev. Div.	Wyndmoor, Pa.
Reed, G.		Ocqueoc, Mich.
Reed, Mrs. G.		Ocqueoc, Mich.
Renwick, W.	Ontario Maple Sirup Producers	Clifford, Ont., Canada
Reynolds, A.	Reynolds Sugar Bush, Inc.	Aniwa, Wis.
Richards, P. S.		Chardon, Ohio
Richards, Mrs. P. S.		Chardon, Ohio
Roberts, N. E.	Information Division, ARS	Wyndmoor, Pa.
Ruuth, H.		Napanee, Ont., Canada
Ruuth, Mrs. H.		Napanee, Ont., Canada
Schmidt, A.		Somerset, Pa.
Schroeder, H.	Schroeder Brothers, Inc.	Antigo, Wis.
Schuler, L. D.	Ohio State University	Burton, Ohio
Shepherd, A. L.	Agricultural Extension Agent	Monterey, Va.
Sills, M. W.	Economic Research Service, USDA	Wyndmoor, Pa.
Sinclair, N. B.	Ontaria Dept. of Agric. & Food	Ottawa, Ont., Canada
Sipple, L.	J. L. Sipple & Son	Bainbridge, N. Y.
Small, O.		Athens, Maine
Small, Mrs. O.		Athens, Maine
Smith, C.	U. S. Forest Service	Burlington, Vt.
Smith, M. E.	University of Minnesota	St. Paul, Minn.
Smith, X. K.		South Dayton, N. Y.
Snow, A. G., Jr.	Northeastern Forest Expt. Station	Burlington, Vt.
Staats, L. T.	Cornell University	Lake Placid, N. Y.
Stransky, P.		Collingwood, Ont., Canada

Name	Organization	Address
Szymujko, J. A.	University of New Hampshire	Durham, N. H.
Taylor, H. S.		Chagrin Falls, Ohio
Treadway, R. H.	Eastern Util. Res. & Dev. Div.	Wyndmoor, Pa.
Tyler, H.		Westford, N. Y.
Underwood, J. C.	Eastern Util. Res. & Dev. Div.	Wyndmoor, Pa.
Wade, W. H.		Petersburg, N. Y.
Wade, Mrs. W. H.		Petersburg. N. Y.
Walker, J.		Syracuse, N. Y.
Walker, Mrs. J.		Syracuse, N. Y.
Watson, R.	Macdonald College	Montreal, Que., Canada
Wells, P. A.	Eastern Util. Res. & Dev. Div.	Wyndmoor, Pa.
Wendt, A. S.	HCA Food Corporation	Brooklyn, N. Y.
White, J. W., Jr.	Eastern Util. Res. & Dev. Div.	Wyndmoor, Pa.
Wiant, T.	Wiant's Sugar Camp	West Liberty, Ohio
Wiant, Mrs. T.		West Liberty, Ohio
Willard, E.	Vermont Dept. of Agriculture	Montpelier, Vt.
Willits, C. O.	Eastern Util. Res. & Dev. Div.	Wyndmoor, Pa.
Winch, F. E., Jr.	Cornell University	Ithaca, N. Y.
Winieski, J.	Pa. Dept. of Forests & Waters	Harrisburg, Pa.
Wright, L.		South Dayton, N. Y.
Zimmerman, J. B.	Stonebridge Farm	Stoystown, Pa.
Zimmerman, Mrs. J. B.	Stonebridge Farm	Stoystown, Pa.